

Six-Year Follow-up of the First Waterloo School Smoking Prevention Trial

BRIAN R. FLAY, DPHIL, DAVID KOEPKE, PhD, SHIRLEY J. THOMSON, MA, SUSANNE SANTI, MSc, J. ALLAN BEST, PhD,
AND K. STEPHEN BROWN, PhD

Abstract: This paper reports six-year follow-up data from the first large-scale randomized trial of the social influences approach to smoking prevention. In 1979, 22 schools were randomly assigned to program or control conditions. Students in program schools received a social influences curriculum in six core and two maintenance sessions in grade 6, two booster sessions in grade 7, and one booster session in grade 8. All students were assessed at pretest (T1), immediate posttest (T2), end of grade 6 (T3), beginning and end of grade 7 (T4 and T5), end of grade 8 (T6), and grades 11 and 12 (T7

and T8). Ninety percent of study students were relocated and data obtained from over 80 percent of them at T8. Program effects on experimental smoking observed in grades 7 and 8 had completely decayed by T8, six years after the beginning of the program. Grade 6 smoking experience and social risk were each strong predictors of T8 smoking behavior. Subjects who had left school were smoking at more than twice the rate of subjects still in high school (grade 12) at T8. We discuss implications of the results. (*Am J Public Health* 1989; 79:1371-1376.)

Introduction

The social influences approach to smoking prevention has proven efficacious in a large number of studies.^{1,2} The approach concentrates on making students aware of the social pressures to smoke—from peers, parents and other adults, and the mass media—and on teaching them behavioral skills with which to resist such pressures. Most studies have reported about 50 percent reduced levels of smoking onset by students exposed to social influences programs when compared to control students, at least in the short term. Ultimately, however, the effectiveness of the tested programs, and of the social influences approach generally, must be assessed from long-term results. We must be able to reduce the prevalence of smoking in high school and beyond.³

Long-term Effects

To date, only a few investigators have reported results of social influence interventions into high school or beyond two years after the intervention (Appendix A).⁴⁻¹⁰ Reported effects become smaller at longer follow-ups, until they disappear altogether at six-year follow-up.¹⁰ Results in all cases are difficult to interpret because of alternative methodological explanations.^{1,2} These methodological problems were overcome in "third generation" studies,^{1,2} of which the Waterloo study was one. The data reported here are the first long-term follow-up data to be reported from a "third generation" study.

The Waterloo Study

The first large-scale randomized trial of the social influences approach to smoking prevention was initiated in Waterloo, Canada in 1979. At that time, 22 schools with grade 6 students were randomly assigned to receive or not receive a social influences curriculum. Grade 6 students in the 11 program schools received a 6-session curriculum from research staff. Two maintenance sessions were provided at the end of grade 6, two booster sessions in grade 7, and one booster session in grade 8. Appendix B provides a summary

of curriculum content, and further details are provided in previous publications.¹¹⁻¹³

Students in both program and control schools were assessed by questionnaire at pretest (T1), immediately after the core program (T2), at the end of grade 6 (T3), at the beginning and end of grade 7 (T4 and T5), and at the end of grade 8 (T6). Potential underreporting of self-reported smoking behavior was minimized by assurances of confidentiality, and collection of a sample of saliva as a modified "bogus pipeline."¹⁴ Results indicated that although the program did not reduce levels of regular smoking or significantly increase the probability of remaining a nonsmoker, it was successful at preventing the onset of experimental smoking up to the end of grade 8.^{12,13} Results were especially encouraging for high-risk students—those at risk to become smokers because they had already tried smoking at grade 6 or because their parents, siblings, and friends were smokers.¹¹

Methods

Subjects

Participants in the first Waterloo smoking prevention trial were reassessed five and six years after the beginning of the study, in grades 11 (T7) and 12 (T8). Extensive tracking procedures resulted in the location of a large percentage of the original subjects. For the 11th grade (T7) assessment, 79 percent (223) of the original 281 subjects from one school board were located and 68 percent were tested. However, failure to obtain cooperation from one school board in time resulted in a failure to assess many subjects in grade 11, and only 40 percent (166) of the 412 subjects from the second school board were located, and 35 percent (143) tested. Overall 56 percent (389) of the subjects were located and 48 percent (335) tested.

The following year we obtained increased cooperation from the second school board. This enabled us to locate 623 (90 percent) of all study students and to obtain questionnaire data from 532 (77 percent) of them and telephone information from an additional 28 (4 percent). Therefore, all outcome results reported below are limited to data from T8 when we obtained responses from most subjects.

Measures

Measures used at T8 were essentially the same as those previously used in grades 6 through 8. In addition to self-reported smoking behavior, students and school leavers were asked for demographic information; reports of smoking habits of parents, siblings, and friends; and information on a

Address reprint requests to Brian R. Flay, PhD, Associate Professor, School of Public Health, and Director, Prevention Research Center, University of Illinois-Chicago, PO Box 6998, (M/C922), Chicago, IL 60680. Dr. Koepke is also at the Prevention Research Center; co-authors Thomson, Santi, Best, and Brown are with the Waterloo Smoking Projects, University of Waterloo, Ontario, Canada. This paper, submitted to the *Journal* November 14, 1988, was revised and accepted for publication March 15, 1989.

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set of mediating variables including knowledge and beliefs regarding smoking, environmental change (from grade school to high school), other substance use, and academic aspirations. Students were also asked for reports of smoking habits of teachers, and information on school environment (including smoking regulations and enforcement).

Smoking behavior categories—On the basis of self-reported smoking behavior, subjects were classified as being in one of five behavioral categories at pretest and at the 12th grade follow-up:

- Never smoker (never smoked even one puff of cigarette);
- Tried once (has smoked, but only once);
- Quitter (has smoked more than once, but has “quit for good”);
- Experimenter (currently smokes, but less than once a week);
- Regular (currently smokes at least once a week or more).

Some analyses reported below compare regular smokers against all others. For some analyses, we also classified subjects as to whether or not they were currently smoking at all.

Pretest social environment risk—Risk levels were based on pretest responses to questions about the smoking habits of parents, siblings, and friends. Levels were defined as follows:

- Low risk (no smoking parents, siblings, or friends);
- Intermediate risk (smokers in only one of the three social model groups);
- High risk (smokers in two or all three social model groups).

Both the behavior smoking category and the social environment classifications depend on multiple questionnaire responses. If needed items were missing, the subjects were unclassifiable and excluded from the analyses. Over 93.5 percent had smoking behavioral categories for both pretest and 12th grade and 91 percent had complete data for all variables used in the analysis.

Procedure

Most subjects were still in school, and in the high schools they expected to be in when they last participated in the study. However, a significant number had changed schools or dropped out. Extensive tracking procedures were initiated to find and assess as many of these students as possible. Those students who had left school or had moved to another area were surveyed by mail (see reference 15 for details).

Those students located in schools in the vicinity of the University of Waterloo were surveyed in classrooms. Participation in measurement was by full informed consent by both the students and their parents. Confidential ID numbers enabled us to match student responses across waves of data collection.

Results

Attrition Analyses

Measures taken at T1 were used in a logistic model^{16,17} to determine whether subjects lost at T8 differed systematically from those who were retained. Effects analyses could be biased to the extent that variables related to outcome behavior also relate to the process of attrition. There was no significant relation between treatment condition and attrition. Neither was there a relation between pretest social environment risk and attrition. However, there was a relation between pretest smoking behavioral category and attrition,

with greater attrition of pretest triers compared to never smokers (odds ratio = 1.84, 95% CI = 1.04, 3.28). Age was also related to attrition. The study retained more subjects who were ages 9–11 at pretest compared to those who were age 12 or older (OR = 2.53, 95% CI = 1.45, 4.39). (These older subjects were more likely to have left school and were thus more difficult to track.) As both students smoking at pretest and older students were more likely to be smoking at the time of the follow-up, these differences tend to bias downward observed smoking rates across all conditions.

Smoking Levels

Approximately 33 percent of all subjects at T8 were regular smokers (95% CI = 27.95, 38.72) and another 10 percent were experimental smokers (95% CI = 6.63, 13.49). By this time only 15 percent had never tried a cigarette (95% CI = 11.07, 19.26).

Students and school leavers—Students and school leavers reported very different patterns of smoking behavior. Approximately 68 percent of school leavers were regular smokers compared to 28 percent of students still in school at grade 12 (OR = 5.54, 95% CI = 3.14, 9.79). Nearly all of the school leavers (98 percent) reported having tried smoking compared to only 84 percent of the students (OR = 12.50, 95% CI = 1.71, 91.8). Figure 1 presents smoking behavioral categories for students in grade 12 and for school leavers.

Measures taken at T1 were used in a logistic model to predict school leaving six years later at T8. There were no significant differences between students and school leavers by original school board, treatment condition, or pretest social environment risk. There were, however, differences by age and by pretest behavioral smoking category. Most of the students were 11 years old at the time of the intervention, but a few were as young as 9 years or as old as 14. Students who were age 12 or older at the time of the pretest were more likely to have left school than those who had been ages 9–11 (OR = 5.05, 95% CI = 2.53, 10.08). Those who had tried smoking once at the time of the pretest were more likely to leave school than those who had never smoked (OR = 2.95, 95% CI = 1.38, 6.29), as were those who had quit (OR = 3.21, 95% CI = 1.30, 7.91) and those who had been regular smokers at the pretest (OR = 7.49, 95% CI = 2.15, 26.09).

However, age and pretest smoking rate differences cannot account for all differences between smoking rates of students and school leavers at the T8 follow-up. When age,

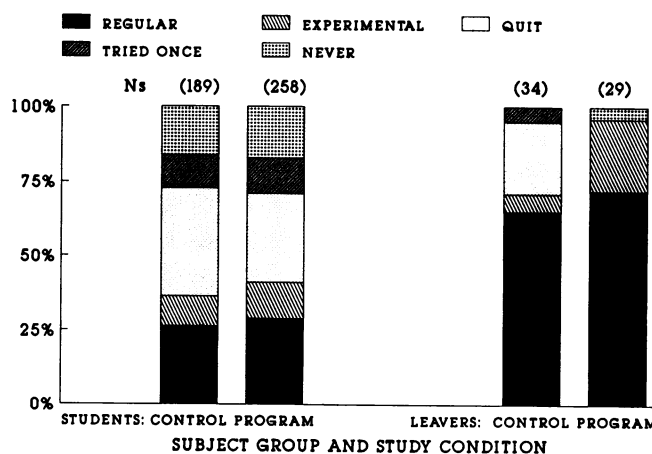


FIGURE 1—Percentage of Grade 12 Students and School Leavers in Smoking Behavior Categories

TABLE 1—Logit Model Summary Table for 12th Grade (T8) Smoking

T1 Predictor of Smoking at T8	Odds Ratio	(95% CI)
Intercept	0.26	(0.15, 0.46)
Smoking Category		
Tried vs Never	1.97	(1.27, 3.06)
Quit vs Never	2.70	(1.46, 4.99)
Experiment vs Never	4.53	(2.19, 9.37)
Regular vs Never	14.35	(3.09, 66.68)
Social Environment Risk		
Intermediate vs Low	1.71	(0.97, 3.02)
High vs Low	2.23	(1.22, 4.07)
Original School Board		
Waterloo vs Oxford	0.69	(0.47, 1.01)
Treatment Condition		
Treatment vs Control	1.22	(0.83, 1.80)

pretest behavioral smoking category, social environment risk, original school board and treatment condition are included with school leaving in a logistic model to predict regular smoking at T8, there is still more regular smoking by school leavers than by students (OR = 2.18, 95% CI = 1.58, 3.01).

Program Effects

Overall program effects also were assessed using a multiple logistic model. The dependent variable is smoking at T8. The primary predictor is treatment condition. The model includes smoking behavioral category at the 6th grade pretest (T1) and pretest social environment risk as additional predictors. These were previously shown to be effective predictors of smoking at the end of 8th grade (T6).^{11,13} Original school board is included as a blocking factor for possible differences between the two populations. Table 1 summarizes the results of this analysis. Interactions of treatment condition with each of these two variables then were added to assess possible differential program effects for students at differing degrees of risk. These interactions were not significant.

By T8 there is no longer a significant overall effect for the treatment program. Both pretest social environment risk ($p < .05$) and pretest smoking behavior ($p < .0001$) predict whether students are smoking more than six years later. The odds ratio indicate that those at low social environment risk in grade 6 are least likely to be smoking six years later. There is no significant difference in smoking rates between the two original school districts. Since the interactions are insignificant, there do not appear to be any differential effects of the treatment program for students at different initial levels of risk for smoking. The overall likelihood-ratio test ($Chi-square = 30.86$, $df = 38$, $p > .75$) indicates that the terms in the model are adequate to account for the observed patterns of responses.

A parallel analysis was done using regular smoking as the outcome measure. Table 2 summarizes these results. A similar pattern of effects is observed for regular smoking (at least once a week) as for smoking at all. There are no overall program effects nor differential program effects for students at differing initial levels of risk. Pretest smoking behavior category ($p < .0001$) predicts whether a student is a regular smoker at T8. Pretest social environment risk is a less strong predictor ($.05 < p < .10$) but the odds ratio are in the same direction for regular smoking as they were for smoking. The likelihood-ratio test ($Chi-square = 43.42$, $df = 38$, $p > .25$)

TABLE 2—Logit Model Summary Table for 12th Grade (T8) Regular Smoking

T1 Predictor of Regular Smoking	Odds Ratio	(95% CI)
Intercept		
Smoking Category		
Tried vs Never	1.67	(1.0, 2.70)
Quit vs Never	3.69	(1.96, 6.93)
Experiment vs Never	4.86	(2.3, 9.92)
Regular vs Never	7.09	(2.2, 22.38)
Social Environment Risk		
Intermediate vs Low	1.12	(0.61, 2.06)
High vs Low	1.75	(0.93, 3.29)
Original School Board		
Waterloo vs Oxford	1.56	(1.03, 2.35)
Treatment Condition		
Treatment vs Control	1.24	(0.83, 1.86)

indicates that the terms in the model are adequate to account for the observed patterns of responses.

Thus, six years after the beginning of the intervention, there were no overall differences between the program and control groups when all students are considered together. Figure 2 displays the proportion of subjects smoking regularly and experimentally at each wave by experimental condition. It demonstrates decay of the significant difference between conditions in level of experimental smoking that was observed at grades 7 and 8.¹³

Considering pretest smoking behavior and social risk categories,¹¹ Figures 3 and 4 show how pretest risk is a strong predictor of subsequent smoking level. The probability of regular smoking in high school increases as grade 6 risk increases; the probability of experimental smoking in high school is lowest for the students at lowest risk in grade 6, and the probability of never smoking by grade 12 decreases as grade 6 risk increases. At grades 7 and 8, we observed significant program effects for the high- and middle-risk students—we did not observe effects for the low-risk students because only a few of them had tried smoking by grades 7 and 8. We observed no significant differential program effects by 12th grade for any risk group.

Discussion

Observed effects of the Waterloo program on the onset

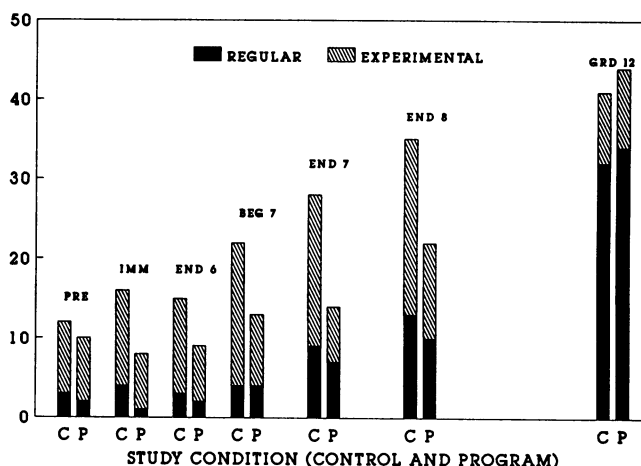


FIGURE 2—Proportion of Subjects Smoking Regularly and Experimentally at Each Wave of the Study

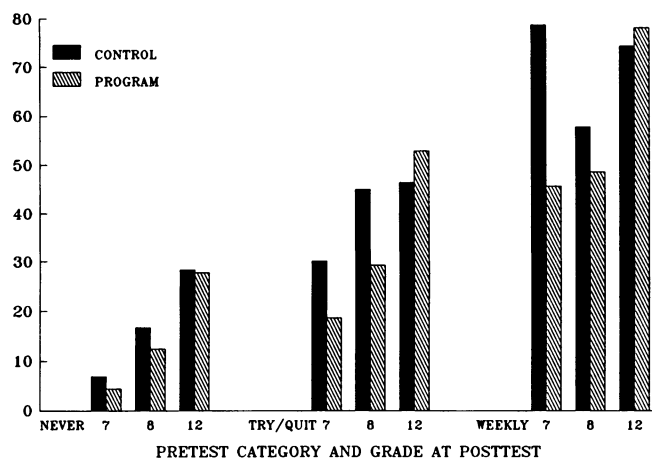


FIGURE 3—Percentage of T8 Subjects Smoking by Pretest Smoking Category and Experimental Condition

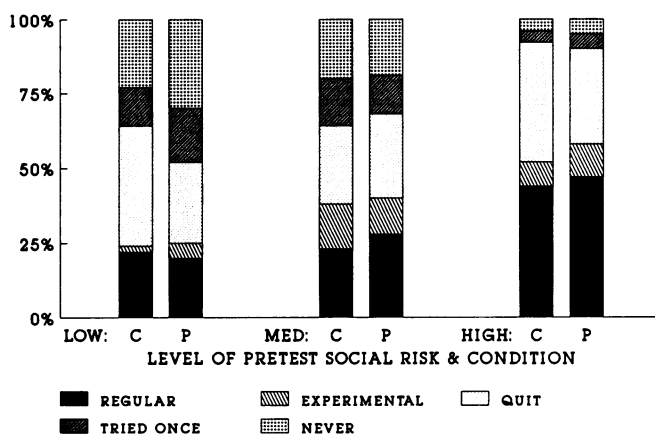


FIGURE 4—Percentage of T8 Subjects in Each Behavioral Category by Pretest Social Risk Level and Experimental Condition

of experimental smoking in grades 7 and 8 were not maintained through grade 12. Expected effects on grade 12 smoking (regular or experimental) did not occur. This finding is consistent with that of the only other study of long-term effects of adolescent smoking prevention programs.^{9,10}

The lack of significant preventive effects by grade 12 raises the question of the value of the social influences approach for smoking prevention. In retrospective non-intervention studies, delayed onset is associated with improved prognosis for quitting and lower incidence of total morbidity and mortality.^{18,19} Prevention program-induced delays in onset may reduce total lifetime exposure and may be an important outcome.¹⁰ This is particularly true if delayed onset increases the probability of earlier quitting. However, the extent to which an intervention-induced delay in onset is associated with earlier or more successful quitting, or even with decreased exposure to toxins, is not established. That would require following the subjects of this study, and others like it, into middle adulthood. We might expect to find earlier

quitting by subjects who are currently smokers but who delayed onset until grade 9 or 10, partly because of the delayed onset and partly because of reduced peer influences.

The value of the social influences approach to preventing the onset of regular smoking by the end of high school needs further study. Results from both the Minnesota and Waterloo studies suggest that program effects obtained in junior high school decay gradually during the following years to totally disappear by grade 12. Such a pattern suggests that booster sessions might be necessary. However, the Waterloo results suggests that boosters in grade 8 are insufficient. These results, together with findings of increased risk at the transition from one level of school to another²⁰ (or from school to college or working), and the importance of school policy variables²¹ suggest the need for boosters in high school. Results of reported high school interventions^{6,22,23} suggest that social influence curricula can be effective with high school students, although effects were small in all cases. Booster sessions were also recommended by an expert advisory panel convened recently by the National Cancer Institute.²⁴

The apparent lack of effects of social influence programs on smoking prevention by grade 12 should not be over-interpreted. First, as noted above, boosters in early high school years may help to maintain early substantial effects. Second, there is a much better understanding today than 10 years ago of the essential components of effective prevention programs.²⁴ These improvements may well mean that current versions of social influence programs may produce more durable effects. Third, the broader social norms are now more supportive of nonsmoking, so that students in control schools may, in fact, have been exposed to many of the elements of the social influence approach during the last five years.

One alarming result of this study is the large difference in smoking behaviors between students and school leavers. These differences cannot be explained by differences in age or by pretest differences in smoking risk or experience, and they also replicate results from the Minnesota group.²⁵ Indeed, they may be underestimated in both the Minnesota and this study because school leavers were followed up less successfully than subjects still in school. The high rates of smoking by early school leavers or dropouts warrant special attention by future research. Prevention programs for youth who will leave or drop out of school will need to go beyond the school setting. Early cessation programs also need to be developed for this group, and these will require components designed to motivate young adults to consider quitting, something which most current smoking cessation programs do not include.

Additional studies of the long-term effects of social influence prevention interventions are necessary. We cannot draw strong inferences from only the two long-term follow-up studies conducted to date. The short-term effects of the social influences approach appeared very promising, but interpretation of their long-term value must await further long-term follow-up studies.

APPENDIX A

Results and Characteristics of Long-term or High School Follow-up Studies on Smoking Prevention

Authors/ Date/Reference	Length of Follow-up (Years)	School Grade of Program	Program Effect (Yes or No)	Methodological Problems (See below)
Evans, <i>et al</i> , 1981 ⁴	3	7	Y	a,b
Telch, <i>et al</i> , 1982 ⁵	2	7	Y	c,d
Johnson, <i>et al</i> , 1986 ⁶	1	10	Y	a,e
Hansen, <i>et al</i> , 1988 ⁷	3	7	Y	a,e
Luepker, <i>et al</i> , 1983 ⁸	2	7	Y	f
Murray, <i>et al</i> , 1988 ⁹	4-5	7	Y	f
Murray, <i>et al</i> , in press ¹⁰	5-6	7	N	f

Methodological problems:

- a) Serious attrition.
- b) Reliance on successive cross-sectional analyses of different subjects.
- c) Pretest differences.
- d) Unable to follow same subjects over time.
- e) Marginal significance.
- f) Pretest differences in direction of expected effects.

APPENDIX B

Summary of Content of the First Waterloo Smoking Prevention Program

Session	Components	Purpose	Methods
Core program (Six one-hour sessions)	Informational	Provide factual basis for the rest of the program.	Film Classroom discussion Poster-making Videotapes Categorization
	Skills Development	Develop and practice skills to resist social influences to smoke.	Videotapes Modeling Role playing
	Decision-making	Integrate other components and express intentions.	Poster-making Decision sheet Public commitment to class
Maintenance (same grade)		Reestablish contact Review	Poster-making Classroom discussion "Talking" videotape Categorization
Booster sessions (grades 7 & 8)		Reestablish contact Review Update information and skills	Classroom discussion Small group work Decision sheet Role playing

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Portions of these data were previously presented at the 6th World Conference on Smoking and Health, Tokyo, Japan, October 1987.

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RWJ Foundation Extends Grants Program for Native American Health Projects

The Robert Wood Johnson Foundation recently awarded nearly \$2 million to fund 13 community health care projects run by and for American Indians and Alaska Natives, and in a further commitment has allocated additional funds to extend the program through 1990.

Believed to represent the first commitment by a major foundation to work directly with tribal governments, the 1989 grants program will target projects designed to prevent alcohol and drug abuse, control diabetes, reduce domestic violence, and improve maternal and infant health among tribal populations in eight states (AZ, ID, MN, MT, NM, OK, SD, and WI). The tribes plan to approach their health problems with imagination and creativity, using traditional Indian methods of care as well as modern medical technology, according to the foundation.

When the call for proposals was issued last fall for the program, "Improving the Health of Native Americans," the foundation received applications from Indian-related groups in 31 states. The high quality and magnitude of that response prompted the foundation to commit additional funds of up to \$2 million to continue the program in 1990.

Tribes and related community organizations interested in applying for funds under the program's second phase should contact Timothy L. Taylor, PhD, Program Director, Improving the Health of Native Americans, College of Public Health, University of Oklahoma Health Sciences Center, PO Box 26901, Oklahoma City, OK 73190. Tel: (405) 271-3221. Dr. Taylor is also a member of the Kiowa Tribe.

Two workshops for potential applicants will be held in November in Nashville, TN and Denver, CO, to answer questions about the program and the application process. For more information about the workshops, contact Dr. Taylor at the address above.

Grants under the program's second phase will be announced in August 1990; proposals must be received by February 1, 1990 to be considered for funding.

The RWJ Foundation, based in Princeton, NJ, is the nation's largest health care philanthropy, established in 1972. Since then, it has awarded more than \$996 million in grants to improve health care in the United States.